EDC430-431 NCTM Mathematics Content Portfolio

One of the ways we assess your development of mathematics content knowledge is by giving you an opportunity to present the best work you have produced during your mathematics courses for each of the National Council of Teachers of Mathematics Content Standards for Teachers. You may submit your portfolio as a PDF file or in paper in a three-ring binder. An electronic version is preferred. In all written work you must follow APA style and use correct grammar and spelling. The portfolio is due on the last day of class in EDC430. Performance criteria are explained in the attached rubric. All evidence you present must be original and graded work from the courses that you took in the mathematics BA program.

Your portfolio needs to consist of the following sections:

1. Introductory Statement
2. Process Standards
3. Content Standards
4. History and Diversity Standards
5. Technology Standards
6. Concluding Statement

Requirements:

1. **Introductory Statement**: In a maximum of two pages describe the contents of your portfolio. Point out specific points that you want the reviewer to pay specific attention to.
2. **Process Standards**: Submit a minimum of two pieces of work (each from a different course) that demonstrate that you have met or exceeded the standards (1-5) in this section. Include a brief description (one-page maximum) with each standard of why you believe this is appropriate evidence. *All your mathematics courses address these first five standards.*

**Standard 1: Knowledge of Mathematical Problem Solving**

Candidates know, understand, and apply the process of mathematical problem solving.

**Indicators**

1.1 Apply and adapt a variety of appropriate strategies to solve problems.

1.2 Solve problems that arise in mathematics and those involving mathematics in other contexts.

1.3 Build new mathematical knowledge through problem solving.

1.4 Monitor and reflect on the process of mathematical problem solving.

**Standard 2: Knowledge of Reasoning and Proof**

Candidates reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and inquiry.

**Indicators**

2.1 Recognize reasoning and proof as fundamental aspects of mathematics.

2.2 Make and investigate mathematical conjectures.

2.3 Develop and evaluate mathematical arguments and proofs.

2.4 Select and use various types of reasoning and methods of proof.

**Standard 3: Knowledge of Mathematical Communication**

Candidates communicate their mathematical thinking orally and in writing to peers, faculty, and others.

**Indicators**

3.1 Communicate their mathematical thinking coherently and clearly to peers, faculty, and others.

3.2 Use the language of mathematics to express ideas precisely.

3.3 Organize mathematical thinking through communication.

3.4 Analyze and evaluate the mathematical thinking and strategies of others.

**Standard 4: Knowledge of Mathematical Connections**

Candidates recognize, use, and make connections between and among mathematical ideas and in contexts outside mathematics to build mathematical understanding.

**Indicators**

4.1 Recognize and use connections among mathematical ideas.

4.2 Recognize and apply mathematics in contexts outside of mathematics.

4.3 Demonstrate how mathematical ideas interconnect and build on one another to produce a coherent whole.

**Standard 5: Knowledge of Mathematical Representation**

Candidates use varied representations of mathematical ideas to support and deepen students’ mathematical understanding.

**Indicators**

5.1 Use representations to model and interpret physical, social, and mathematical phenomena.

5.2 Create and use representations to organize, record, and communicate mathematical ideas.

5.3 Select, apply, and translate among mathematical representations to solve problems.

1. **Content Standards**: For each content standard present at least two, and a maximum of three, assignments that demonstrate that you have met or exceeded the listed standards. Include a brief description (one-page maximum) with each standard of why you believe this is appropriate evidence.

**Standard 9: Knowledge of Number and Operation** (*Evidence may be taken from any of the mathematics courses you have taken*)

Candidates demonstrate computational proficiency, including a conceptual understanding of numbers, ways of representing number, relationships among number and number systems, and meanings of operations.

**Indicators**

9.1 Analyze and explain the mathematics that underlies the procedures used for operations involving integers, rational, real, and complex numbers.

9.2 Use properties involving number and operations, mental computation, and computational estimation.

9.3 Provide equivalent representations of fractions, decimals, and percents.

9.4 Create, solve, and apply proportions.

9.5 Apply the fundamental ideas of number theory.

9.6 Make sense of large and small numbers and use scientific notation.

9.7 Compare and contrast properties of numbers and number systems.

9.8 Represent, use, and apply complex numbers.

9.9 Recognize matrices and vectors as systems that have some of the properties of the real number system.

**Standard 10: Knowledge of Different Perspectives on Algebra** (*Evidence may be taken from any of the mathematics courses you have taken*)

Candidates emphasize relationships among quantities including functions, ways of representing mathematical relationships, and the analysis of change.

**Indicators**

10.1 Analyze patterns, relations, and functions of one and two variables.

10.2 Apply fundamental ideas of linear algebra.

10.3 Apply the major concepts of abstract algebra to justify algebraic operations and formally analyze algebraic structures.

10.4 Use mathematical models to represent and understand quantitative relationships.

**Standard 11: Knowledge of Geometries** (*Predominantly MTH 322*)

Candidates use spatial visualization and geometric modeling to explore and analyze geometric shapes, structures, and their properties.

**Indicators**

11.1 Demonstrate knowledge of core concepts and principles of Euclidean and non-Euclidean geometries in two and three dimensions from both formal and informal perspectives.

11.2 Exhibit knowledge of the role of axiomatic systems and proofs in geometry.

11.3 Analyze characteristics and relationships of geometric shapes and structures.

11.4 Build and manipulate representations of two- and three- dimensional objects and visualize objects from different perspectives.

11.5 Specify locations and describe spatial relationships using coordinate geometry, vectors, and other representational systems.

11.6 Apply transformations and use symmetry, similarity, and congruence to analyze mathematical situations.

**Standard 12: Knowledge of Calculus** (*Predominantly MTH 141, MTH 142, MTH 243, and also MTH 451*)

Candidates demonstrate a conceptual understanding of limit, continuity, differentiation, and integration and a thorough background in the techniques and application of the calculus.

**Indicators**

12.1 Demonstrate a conceptual understanding of and procedural facility with basic calculus concepts.

12.2 Apply concepts of function, geometry, and trigonometry in solving problems involving calculus.

12.3 Use the concepts of calculus and mathematical modeling to represent and solve problems taken from real-world contexts.

**Standard 13: Knowledge of Discrete Mathematics** (*Predominantly MTH477or MTH340*)

Candidates apply the fundamental ideas of discrete mathematics in the formulation and solution of problems.

**Indicators**

13.1 Demonstrate knowledge of basic elements of discrete mathematics such as graph theory, recurrence relations, finite difference approaches, linear programming, and combinatorics.

13.2 Apply the fundamental ideas of discrete mathematics in the formulation and solution of problems arising from real-world situations.

13.3 Use technological tools to solve problems involving the use of discrete structures and the application of algorithms.

**Standard 14: Knowledge of Data Analysis, Statistics, and Probability** (*Predominantly MTH 451*)

Candidates demonstrate an understanding of concepts and practices related to data analysis, statistics, and probability.

**Indicators**

14.1 Design investigations, collect data, and use a variety of ways to display data and interpret data representations that may include bivariate data, conditional probability, and geometric probability.

14.2 Use appropriate methods such as random sampling or random assignment of treatments to estimate population characteristics, test conjectured relationships among variables, and analyze data.

14.3 Use appropriate statistical methods and technological tools to describe shape and analyze spread and center.

14.4 Use statistical inference to draw conclusions from data.

14.5 Identify misuses of statistics and invalid conclusions from probability.

14.7 Determine and interpret confidence intervals.

**Standard 15: Knowledge of Measurement** (*Predominantly MTH 141, MTH 142*)

Candidates apply and use measurement concepts and tools*.*

**Indicators**

15.1 Recognize the common representations and uses of measurement and choose tools and units for measuring.

15.2 Apply appropriate techniques, tools, and formulas to determine measurements and their application in a variety of contexts.

15.3 Completes error analysis through determining the reliability of the numbers obtained from measures.

1. **History and Diversity Standards**: In your mathematics courses begin to explore the historical development of mathematics through a look at the contributions of specific mathematicians or cultures to each of the following areas of mathematics:

1. Knowledge of Number and Operation (9.10 Demonstrate knowledge of the historical development of number and number systems including contributions from diverse cultures. MTH 307 and MTH 382)

2. Knowledge of different perspectives on Algebra (10.6 Demonstrate knowledge of the historical development of algebra including contributions from diverse cultures. MTH316)

3. Knowledge of Geometries (11.8 Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures. MTH322)

4. Knowledge of Calculus (12.5 Demonstrate knowledge of the historical development of calculus including contributions from diverse cultures. MTH141, MTH142, MTH 243)

5. Knowledge of Discrete Mathematics (13.4 Demonstrate knowledge of the historical development of discrete mathematics including contributions from diverse cultures. MTH447 or MTH340)

6. Knowledge of Data Analysis, Statistics, and Probability (14.8 Demonstrate knowledge of the historical development of statistics and probability including contributions from diverse cultures. MTH451)

7. Knowledge of Measurement (15.4 Demonstrate knowledge of the historical development of measurement and measurement systems including contributions from diverse cultures. MTH141, MTH142)

For each of the seven areas of mathematics above, select at least one mathematician or culture and describe their main contributions to that area in your portfolio. Each description should be approximately 2-3 pages and include:

A. a brief biographical or historical description of the mathematician or culture,

B. a non-technical description of their main contribution(s) to the area,

C. how these contributions influenced political/social/cultural events and/or the development of mathematics, and

D. how you would include this mathematical history (as appropriate) in a secondary mathematics course.

This section of your portfolio should reflect a diverse group of mathematicians and cultures. On a separate page, using APA style, create a reference list, giving all the sources you used.

1. **Technology Standards**: For each of the standards below present one exemplary piece of original work from one of the listed courses. Explain how each piece of work demonstrates that you have met or exceeded that standard. Write a one-page summarizing statement how this work has prepared you for implementing technology in your future teaching.

**Standard 6: Knowledge of Technology**

Candidates embrace technology as an essential tool for teaching and learning mathematics.

**Indicator**

6.1 Use knowledge of mathematics to select and use appropriate technological tools, such as but not limited to, spreadsheets, dynamic graphing tools, computer algebra systems, dynamic statistical packages, graphing calculators, data-collection devices, and presentation software. (MTH141, MTH142, MTH 215, MTH 243, MTH 322, MTH 451)

10.5 Use technological tools to explore algebraic ideas and representations of information and in solving problems. (MTH141, MTH142, MTH 215, MTH 243)

11.7 Use concrete models, drawings, and dynamic geometric software to explore geometric ideas and their applications in real-world contexts. (MTH322)

12.4 Use technological tools to explore and represent fundamental concepts of calculus. (MTH141, MTH142, MTH 215, MTH 243)

13.3 Use technological tools to solve problems involving the use of discrete structures and the application of algorithms. (MTH447)

14.3 Use appropriate statistical methods and technological tools to describe shape and

analyze spread and center. (MTH451)

14.6 Draw conclusions involving uncertainty by using hands-on and computer-based simulation for estimating probabilities and gathering data to make inferences and conclusions. (MTH451)

1. **Concluding Statement**: In a maximum of three pages explain the impact of the coursework you have completed in mathematics to your future teaching. In particular reflect on your work in MTH420. Finish with recommendations you have for improving the mathematics BA program.

Note:

You will develop evidence for NCTM standards 7 (Disposition), 8 (Knowledge of Mathematics Pedagogy), and 16 (Field-Based Experiences) in other parts of your program.

Portfolio Performance Criteria:

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| --- | --- | --- | --- | --- |
| Criterion | Well above the Standard (5) | Above the Standard (4) | Meets the Standard (3) | Does not meet the Standard (2) |
| Introductory statement | The introduction is clearly written with no grammatical, spelling, and punctuation errors, consistently using APA style. | The introduction is clearly written with very few grammatical, spelling, and punctuation errors, consistently using APA style. | The introduction is sufficiently clearly written with a few grammatical, spelling, and punctuation errors, using APA style. | The introduction is difficult to follow and/or incomplete with many grammatical, spelling, and punctuation errors, inconsistently using APA style. |
| Process Standards (NCTM 1-5) | Candidate presents two strongly representative samples of work that exemplify the skilled, effective, and efficient use of all process standards. Candidate clearly articulates the strength of the evidence. | Candidate presents two clearly representative samples of work that demonstrate the skilled, effective, and efficient use of all process standards. Candidate clearly articulates the strength of the evidence. | Candidate presents two adequately representative samples of work that demonstrate the competent use of at least three process standards. Candidate adequately articulates the strength of the evidence. | Candidate presents two or less samples of work that may not be representative of the process standards. Less than three standards are addressed. Candidate weakly articulates the strength of the evidence. |
| Content Standards (NCTM 9-15) | Candidate presents three strongly representative samples of work that exemplify the thorough and deep mathematical knowledge for each of the seven content standards, addressing at least 90% of the criteria for each standard. Candidate clearly articulates the strength of the evidence for each standard. | Candidate presents three clearly representative samples of work that demonstrate the thorough mathematical knowledge for each of the seven content standards, addressing at least 80% of the criteria for each standard. Candidate clearly articulates the strength of the evidence for each standard. | Candidate presents two or three representative samples of work that demonstrate the adequate mathematical knowledge for each of the seven content standards, addressing at least 70% of the criteria for each standard. Candidate adequately articulates the strength of the evidence for each standard. | Candidate presents less than two samples of work that may not be representative of the indicated standard. Mathematical knowledge demonstrated may be incomplete or incorrect. Less than 70% of the criteria for each standard are addressed. Candidate poorly articulates the strength of the evidence for each standard. |
| History Standards (NCTM 9-15) | Candidate gives a concise and thorough historical description of a diverse set of mathematicians and cultures, describing important contributions in an understandable manner for all indicators. The historical implications of these contributions are made relevant. Instructional implications are realistic and sound. | Candidate gives a thorough historical description of a diverse set of mathematicians and cultures, describing important contributions in an understandable manner for all indicators. The historical implications of these contributions are clear. Instructional implications are sound. | Candidate gives a sufficient historical description of an adequately diverse set of mathematicians and cultures, describing contributions in an understandable manner for at least five indicators. The historical implications of these contributions are described adequately. Instructional implications are reasonable. | Candidate gives an incomplete, or missing, or inaccurate historical description of a set of mathematicians and cultures, which lack diversity, poorly or erroneously describing contributions for less than six indicators. The historical implications of these contributions are lacking, or incorrect, or superficial. Instructional implications are lacking or unsound. |
| Technology Standards (NCTM 6, 10-14) | Candidate provides strongly representative evidence for the skilled and purposeful use of technology in the learning of mathematics, and clearly and thoroughly articulates the strength of this evidence for all indicators. | Candidate provides representative evidence for the skilled and purposeful use of technology in the learning of mathematics, and clearly articulates the strength of this evidence or all indicators. | Candidate provides representative evidence for the skilled use of technology in the learning of mathematics, and adequately articulates the strength of this evidence for at least six indicators. | Candidate provides evidence that inconsistently or inadequately provides evidence for the use of technology in the learning of mathematics, and inadequately articulates the strength of this evidence for less than six indicators. |
| Concluding statement | The conclusion is clearly written with no grammatical, spelling, and punctuation errors, consistently using APA style.  The statement pulls together the aggregate of evidence and makes a compelling and convincing case for achievement of mathematical knowledge and the implications for the candidate’s future work as a mathematics teacher. | The conclusion is clearly written with very few grammatical, spelling, and punctuation errors, consistently using APA style.  The statement pulls together the aggregate of evidence and makes a strong case for achievement of mathematical knowledge and the implications for the candidate’s future work as a mathematics teacher. | The conclusion is sufficiently clearly written with a few grammatical, spelling, and punctuation errors, using APA style.  The statement pulls together the most of evidence and makes a reasonable case for achievement of mathematical knowledge and the implications for the candidate’s future work as a mathematics teacher. | The conclusion is difficult to follow and/or incomplete with many grammatical, spelling, and punctuation errors, inconsistently using APA style.  The statement does not pull the evidence together and does not make a reasonable case for achievement of mathematical knowledge. Consideration for implication for work as a mathematics teacher are weak, or incomplete, or absent. |